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D.G.E -HR.SEC. EXAMINATION MARCH - 2014

REGISTER NUMBER **606676**

CANDIDATE NAME : **AKALYA M**

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GROUP CODE : **103**

SUBJECT : **005 PHYSICS E**

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D.G.E -HR.SEC. EXAMINATION MARCH - 2014

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SUBJECT :

005 PHYSICS E

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AB.1705 38/03/04 C59

அரசுத் தேர்வுகள் துறை

DEPARTMENT OF GOVERNMENT EXAMINATIONS

Script No. 04

Total Marks 1 4 9

11/4/14 CE 11/4/14

HSE

விடைத்தாள் திருத்துவோர் நிறைவு செய்ய வேண்டியவை

FOR THE USE OF EXAMINERS ONLY

வினாவாரியாக மொத்தம் Questionwise Total										பக்கவாரியாக மொத்தம் Pagewise Total			
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13	1	35	3	57	5	79		101		13	2	35	3
14	1	36	3	58	4	80		102		14	3	36	2
15	1	37	3	59		81		103		15	1	37	1
16	1	38	3	60	5	82		104		16	12	38	4
17	1	39		61		83		105		17	23	39	0
18	1	40	3	62		84		106		18	5	40	2
19	1	41	3	63		85		107		19	3	41	3
20	1	42	3	64		86		108		20	2	42	2
21	1	43	3	65		87		109		21	5	43	12
22	1	44	3	66	10	88		110		22	12	44	3
மொத்தம் Total	22	மொத்தம் Total	47	மொத்தம் Total	50	மொத்தம் Total	293	மொத்தம் Total		மொத்தம் Total	1012	மொத்தம் Total	44 3

வினாவாரியாக ஒட்டு மொத்தம் Question-wise Grand Total: 1482

149

பக்கவாரியாக மொத்தம் Page-wise Total: 1482

149

தேர்வு எழுதுபவர் செய்யக்கூடியவை மற்றும் செய்யக்கூடாதவை

Do's & Don'ts for Candidates

1. முகப்புச்சீட்டில் உரிய இடத்தில் கையொப்பமிட வேண்டும்.

   Put your signature in the Top sheet in the appropriate place.

2. விடைத்தாளில் ஒரு பக்கத்திற்கு 20 முதல் 25 வரிகள் வரை எழுதவேண்டும்.

   Write 20 to 25 lines in a page.

3. விடைத்தாளின் இருபுறத்திலும் எழுத வேண்டும்.

   Write answers in both sides of paper.

4. செய்முறைகள் யாவும் விடைத்தாளின் கீழ் பகுதியில் இடம் பெறவேண்டும்.

   All rough works must be done on the lower part of the page.

5. வினா எண் தவறாமல் எழுத வேண்டும்.

   Write the question numbers without fail.

6. இரு விடைகளுக்கிடையே இடைவெளி விட்டு எழுத வேண்டும்.

   Leave space between two answers.

7. வினாத்தாளின் வரிசை (A or B) எழுத வேண்டும்.

   Write the question paper booklet series. (A or B)

8. விடைத்தாளில் நீலம்/கருப்புமை கொண்ட பேனாவால் விடைகளை தெளிவாக எழுத வேண்டும்.

   Anwers must be legibly written either in Blue or Black ink pen.

9. விடைத்தாளில் எழுதாத பக்கங்களில் குறுக்குக்கோடு இடவேண்டும்.

   Cross the unwritten pages.

1. வினாத்தாளில் எந்தவித குறியீடும் இடக்கூடாது.

   No marking in the question paper.

2. விடைத்தாளை சேதப்படுத்தக் கூடாது.

   Don't damage the answer paper.

3. விடைத்தாளில் எந்த ஒரு பக்கத்திலும் தேர்வு எண்/பெயர் எழுதக்கூடாது.

   Don't write name / Register Number in any page of the answer book.

4. வண்ணக்கலர் கொண்ட பேனா/ பென்சில் எதையும் பயன்படுத்தக் கூடாது.

   Don't write with sketch colour pencils.

5. விடைத்தாள் கோட்டின் இடது பக்கத்தில் எழுதக்கூடாது.

   Don't write on the margin.

6. விடைத்தாள் புத்தகத்தின் எந்த தாளையும் கிழிக்கவோ/நீக்கவோ கூடாது.

   Don't tare / remove any page from the answer book.

PART - I

1. a) $\frac{1}{x^2}$

2. c) $\frac{\sigma}{\varepsilon_0}$

3. b) $\frac{q}{4}\sqrt{k}$ metre

4. a) 2×10^{-9} N

5. b) $x^2 : 1$

6. a) $\pi \times 10^{-5}$ T

7. c) high specific resistance

8. b) 0.25 H

9. a) AC only

10. b) Room heater

$\frac{nRn}{R}$ $\quad \frac{n}{R}$ $\quad F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ $\quad F = E$ $\quad E = \frac{F}{q_0}$ $\quad e = L\frac{di}{dt}$

$e = 25$ $\quad F = 10 \times 2\times10^{-10}$

$\frac{R}{n} 16 = 9\times10^9 \frac{x - q^2}{r^2}$ $\quad L = \frac{-e}{\frac{dI}{dt}}$ $\quad F = k\frac{q_1 q_2}{r^2}$ $\quad 2\times10^{-7}$

$\frac{\mu_0 nI}{2a}$ $\quad = \frac{-25}{100}$ $\quad r^2 = \frac{kq_1q_2}{16}$

$\frac{2\pi \times 10^{-7} \times \cancel{5} \times 10^2}{4\pi\times10^{-7}}$ $\quad r^2 = 9\times10^9 \frac{x - q^2}{16} = -\frac{1}{4}$ $\quad = 0.\cancel{25}$ $\quad = \frac{\sqrt{kq}}{4}$

$\pi \times 10^{-5}$ $\quad \cancel{2}\times \cancel{100} \, 10^{\cancel{5}} =$ $\quad \frac{3\times10^3 q}{4}$

11. a) the average value of current is zero

12. b) power is transmitted in a direction perpendicular to both the fields.

13. ~~a) contracts~~ a) pure line spectrum

14. a) contracts

15. d) topaz

16. b) absorbs green light

17. a) a stream of electrons

18. c) phase and amplitude

19. b) 10.2 eV

20. a) $\lambda = \frac{h}{\sqrt{2mE}}$

9

21. a) zero

22. d) $_{11}Na^{24}$

23. c) isotones

24. b) mean life

25. c) 931 MeV

26. d) type of semiconductor material.

27. b) 2.0V

28. a) A

29. c) ionospheric propogation.

30. b) twice the signal frequency.

$\frac{2.7}{0.7}$

PART - II

31. **Electric dipole moment** :

Electric dipole moment is defined as the product of magnitude of one of the charges and the distance between charges.

$$p = q \times 2d$$

$$\boxed{p = 2qd}$$

p - dipole moment

Its acts from $-q$ to $+q$

Its is a vector quantity.

Unit : Cm

3

---

32) Given :

$q = 4 \times 10^{-7}$ c

$r = 0.09$ m

Formula :

$$V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$$

$$= \frac{9\times10^{9}\times4\times10^{-7}}{0.09} = \frac{36\times10^{2}}{9\times10^{-2}} = 4\text{ V}$$

$\frac{36\times10^{2}\times10^{-2}}{9}$

$\frac{36\times10^{2}}{9\times10^{-2}}$

$\frac{9\times10^{9}\times4\times10^{-7}}{9\times10^{-2}}$

3

6

33. Changes observed at Transistion temperature :

(i) The electrical resistivity becomes zero.

(ii) The conductivity becomes infinity.

(iii) The magnetic flux lines are excluded from the material.

---

34. Kirchoff's Voltage Law :

Kirchoff's voltage law states that the algebraic sum of product of current and Resistance in each part of any closed circuit is equal to the algebraic sum of the emfs present in that closed circuit.

This law is a consequence of conservation of energy

6

35. Given :

3

$V = 240\,V$

$I = 0.5\,A$

$R = ?$

Formula,

By ohm's law

$V = IR$

$R = \frac{V}{I}$

$R = \frac{240}{0.5}$

$= \frac{2400}{5} = 480\,\Omega$

$\frac{2400}{5} = 8\,480$

$\frac{2400}{5} = 480$

Ans: Resistance = $480\,\Omega$

36. Peltier coefficient (π)

3

. The amount of heat energy absorbed or evolved in any one of the junctions when unit current flows in the circuit for one second (1 coulomb) is

6

called Peltier coefficient.

$$\boxed{\pi = VIt}$$

Its unit is volt.

It depends on the temperature of the junctions.

37. Lenz law :

Lenz law states that the induced current produced in a circuit always flows in such a direction that it opposes the change or cause that produces it.

This is a consequence of conservation of energy.

$$e = -\frac{d\phi}{dt} = -\frac{d}{dt}(NBA) = -NA\frac{dB}{dt}$$

3

3

38.

Given:

$N = 200$

$A = 0.04 m^2$

$\phi_1 = 0.1 \ wbm^{-2}$

$\phi_2 = 0.04 \ wbm^{-2}$.

$t = 0.02$

$e = ?$

Soln:

$$e = -\frac{d}{dt}(NAB)$$

$$= -NA\left(\frac{dB}{dt}\right)$$

$$= -NA\frac{(\phi_2 - \phi_1)}{t}$$

$$= -200 \times 0.04 \frac{(0.04 - 0.1)}{0.02}$$

$$= -200 \times 0.04 \times \frac{-0.06}{0.02}$$

$$= \frac{200 \times 0.04 \times 0.06}{0.02}$$

$$= 24 V$$

0.04
0.1

0.10
0.04
0.06

800

$\frac{200 \times 0.04 \times 0.06}{0.02}$

$8 \times 3 = 24$.

40. Conditions for Total Internal Reflections :

2 (i) The light must travel from denser medium to rarer medium.

(ii) The angle of incidence (i) inside the denser medium should be greater than the critical angle (c) 2

$\boxed{i > c}$

41.

Soft x-rays	Hard x-rays
2 (i) They have wavenlength of upto $4 \mathring{A}$.	They have wavelength of $1 \mathring{A}$ or below.
(ii) They have low penetrating power and hence called soft x-rays.	They have high penetrating power. 2
(iii) They have low energy, low frequency and produced at low potential difference	They have high energy, high frequency and produced at high potential difference comparatively.

6

42. 3 Given :

$$E = 3.4 \times 10^4 \ V/m$$

$$B = 2 \times 10^{-3} \ T$$

$$v = ?$$

Soln :

$$B\cancel{e}V = E\cancel{e}$$

$$v = \frac{E}{B}$$

$$v = \frac{3.4 \times 10^4}{2 \times 10^{-3}}$$

$$v = \underline{1.7 \times 10^7 \ m/s}$$

$\frac{3.4}{2} = 1.7$

43. Applications of photoelectric cells :

3 (i) They are used in automatic switching on and off of street lights.

2

(ii) They are used in automatic opening and closing of doors.

0

(iii) They are used to study the temperature and spectra of stars.

44. Properties of 'n':

2 (i) They are the basic constituents of all atoms except hydrogen atom.

(ii) As they are neutral, they can penetrate easily inside any nucleus.

(iii) They do not have any charge, mass slightly greater that of protons. They are not deflected by electric and magnetic fields.

47. Advantages of IC:

(i) Extremely small in size

(ii) very small weight

(iii) Low cost

(iv) Easy replacement

(v) Reliability

(vi) High efficiency

2.

45. Pair production :

The phenomenon by which high energy photon produces electron positron pair in a electric field sorrounding the nucleus is called pair production

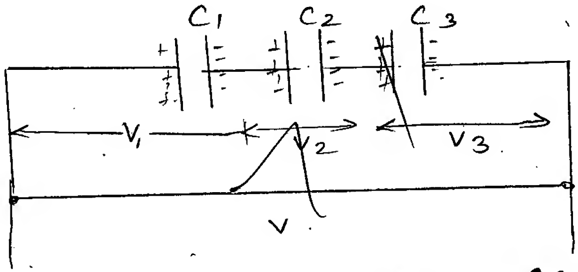
The reversal of pair production in which electron positron pair combine to form a photon is called annihilation of matter

50. Skip distance :

In sky wave propogation, for a given frequency, the shortest distance between the point of transmission and point of reception is called skip distance

PART - III

51. **Capacitance in series :**



Let us consider three capacitors of capacitances C_1, C_2, C_3 connected in series.

A potential of 'V' is connected across the capacitors.

When the capacitors are connected in series, the charge flowing through each capacitor is the same.

The voltage flowing through C_1, C_2, C_3 be V_1, V_2, V_3 respectively.

$$V_1 = \frac{q}{C_1}, \quad V_2 = \frac{q}{C_2}, \quad V_3 = \frac{q}{C_3}.$$

$$V = V_1 + V_2 + V_3$$

$$V = \frac{q}{C_1} + \frac{q}{C_2} + \frac{q}{C_3}$$

$$V = q\left[\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right] \longrightarrow (1)$$

Let C_s be the effective capacitance connected in series when a voltage of 'V' is produced when given a charge 'q'

$$V = \frac{q}{C_s} \longrightarrow (2)$$

Sub (2) in (1)

$$\frac{q}{C_s} = q\left[\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}\right]$$

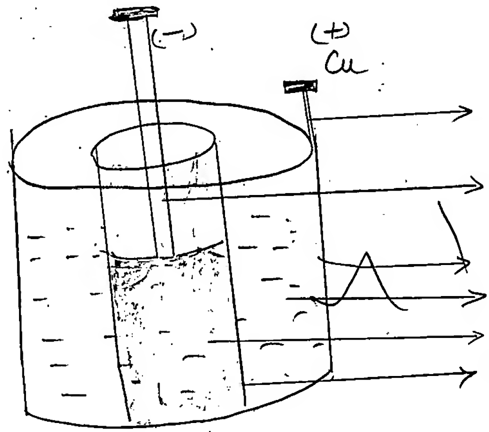
$$\boxed{\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}}$$

The effective capacitance of the capacitances is given by the relation.

$$\frac{1}{C_S} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}.$$

The reciprocal of the effective capacitance of the series combination is equal to the sum of the reciprocals of the capacitances of individual capacitors.

52. Daniel cell:



Construction :

(i) Daniel cell is one of the primary cell and does not give current for a long time.

(ii) It consists of a copper vessel which acts as anode.

(iii) A porous pot which contains zinc rod dipped in H_2SO_4 is kept inside the glass vessel which acts as cathode (zinc)

(iii) The glass vessel contains $CuSO_4$ which is electrolyte.

Working :

1) At Zn rod, Zn dissolves in H_2SO_4 producing Zn^{++} and 2 electrons

2) The two electrons remain at the zinc electrode making it negative.

3) The Zn^{++} pass through the porous pot and react with $CuSO_4$ producing Cu^{++} ions.

4) Cu^{++} ions get deposited at the anode thus making it positive.

5) When they are connected in external circuit, the current flows from Cu to Zn.

6) The two electrons from Zn rod continuously move from Zn to Cu vessel. this makes the conventional current to flow in opposite direction.

7) The emf produced in the cell is about 1.08 volts.

54. Given :

$I = 4A$

$N = 5$

$d = 30\ cm$

$a = \frac{30}{2} \times 10^{-2} = 15 \times 10^{-2}\ m$

$B_H = 4 \times 10^{-5}\ T$

$\theta = ?$

Formula :

$$I = \frac{2aB_H \tan\theta}{\mu_0 n}$$

$$\tan\theta = \frac{\mu_0 n I}{2aB_H}$$

$$= \frac{\cancel{4}\pi \times 10^{-7} \times \cancel{5} \times \cancel{4}^{2}}{\cancel{2} \times 15 \times 10^{-2} \times \cancel{4} \times 10^{-5}}$$

$$= \frac{3.14 \times 5}{15} \times 10^{7} \times 10^{-7} \times 2$$

$$\tan\theta = 2.093$$

$$\theta = \tan^{-1}(2.093)$$

$$\theta = 64^\circ 28'$$

$\frac{31.4}{15}$

$15 \overline{)31.4}$ 2.093
30
140
135
50
45

55 Self Inductance of long solenoid :

Let us consider a solenoid of length 'l', area of cross section 'A', carrying a current I. Let 'n' be the number of turns

Magnetic field inside a solenoid of n turns is $B = \mu_0 \frac{N}{l} I$

Magnetic flux per turn of the solenoid = $B \times$ Area of each turn

$$= B \times A$$

$$= \frac{\mu_0 N I}{l} \times A$$

The total magnetic flux (ϕ) through the solenoid = Magnetic flux per turn $\times$ Number of turns of solenoid

$$\phi = BA \times N$$

$$\phi = \frac{\mu_0 N I A}{l} \times N$$

$$\boxed{\phi = \frac{\mu_0 N^2 I A}{l}} \rightarrow (1)$$

But, we know that,

$$\boxed{\phi = LI} \rightarrow (2)$$

L is the self inductance of solenoid

Equating (1) & (2).

$$L\cancel{I} = \frac{\mu_0 N^2 \cancel{I} A}{l}$$

$$\boxed{L = \frac{\mu_0 N^2 A}{l}}$$

If the solenoid is placed in a medium of permeability μ, then,

$$\boxed{L = \frac{\mu N^2 A}{l}}$$

57. Properties of canal rays:

5

(i) They are streams of positive ions of the gas present in the discharge tube. They have properties opposite to that of cathode rays. Their direction of deflection is opposite to cathode rays.

5

(ii) Their velocity is less than the cathode rays.

(iii) They produce fluorescence.

(iv) They affect photographic plates.

(v) They ionise the gas through which they pass.

5

58. Einstein's photoelectric equation:

In 1905, Einstein studied a relationship between photoelectric current with quantum theory of light

According to him, when a photon of energy $h\nu$, is incident on a metal plate, the energy is used up in two ways.

(i) A part of the energy of photon is used to remove an photoelectron from the metal surface. The electrons are tightly held to the nucleus. This energy required is called work function (W) of the material.

Work function is defined as the minimum energy required to liberate a electron from the metal surface. This is characteristic of the metal.

(ii) The remaining part of the energy is used to impart kinetic energy to the liberated electron.

$$\boxed{\text{Energy of photon} = \text{Work function} + \text{Kinetic energy of the photon.}}$$

Maximum kinetic energy:

If the liberated photon does not lose energy by collissions, then the remaining energy $(h\nu - W)$ will be converted to kinetic energy. If v_{max} is the maximum velocity of the liberated electron then,

$$h\nu = W + \frac{1}{2} m v_{max}^2$$

Zero kinetic energy :

When the liberated electron loses its energy by collision and also if the photon is incident at threshold frequency (ν_0), the velocity of photoelectron liberated will be zero.

$$\boxed{W = h\nu_0}$$ {since Kenetic energy of photoelectron is zero}

If ν, is the velocity of photoelectron.

then,

$$\boxed{h\nu = h\nu_0 + \frac{1}{2}mv_{max}^2}$$

$$\boxed{h(\nu - \nu_0) = \frac{1}{2}mv_{max}^2}$$

This is called Einstein's photoelectric equation

60) Given :

Energy = 32×10^6 W.

Energy per fission = 200 MeV.

No. of fissions = ?

Soln :

Energy per fission = 200 MeV

$= 200 \times 10^6 \times 1.6 \times 10^{-19}$ J.

Energy per fission × Number of fission = Energy liberated.

$$\text{Number of fissions} = \frac{\text{Energy developed in reactor}}{\text{Energy per fission}}$$

$$= \frac{32 \times 10^6 \text{ J/s}}{200 \times 10^6 \times 1.6 \times 10^{-19} \text{ J}}$$

$$= \frac{32 \times 10^6}{32 \times 10 \times 10^6 \times 10^{-19}} /\text{sec}$$

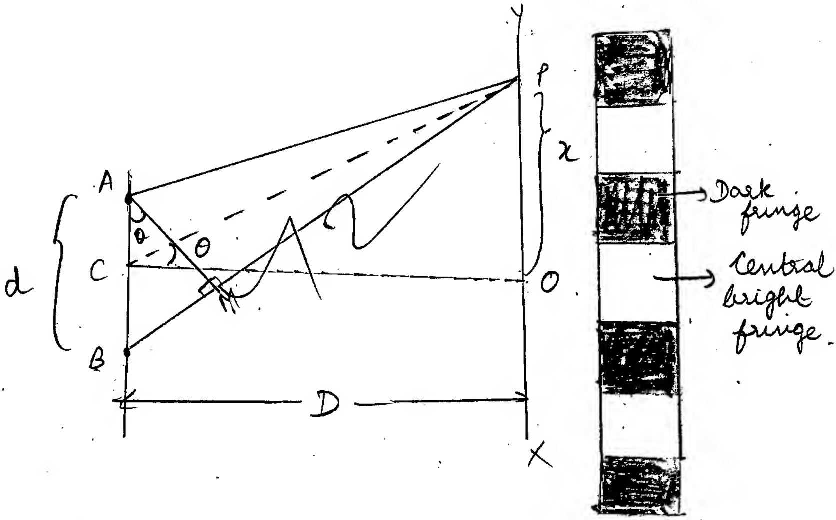
$$= 10^{-1} \times 10^{19} / \text{sec}$$

$$N = 10^{18} \text{ fissions / sec}$$

∴ Number of fissions = 1×10^{18} fissions per second

PART - IV

66. Young's double slit experiment :



1) Let us consider two coherent sources A, B seperated by a distance 'd' light of wavelength λ. Let C be the mid point of the sources A & B. Let XY be the screen placed at a distance 'D' from the sources. Let 'O' be the point of XY which is equidistant from C.

(i) Let P be a point on the screen at a distance 'x' from 'O'.

(iii) The fringes at P depend upon the path difference between the waves AP and BP which produce the fringe.

To find the path difference :

The path difference between the waves AP and BP is δ.

$$\delta = BP - AP$$

Let AM $\perp^{r}$ drawn to BP at M.

$$\therefore AP = MP.$$

$$\delta = BP - AP = BP - MP = \underline{\underline{BM}}.$$

$$\boxed{\delta = BM} \rightarrow ①$$

In rt $\triangle$ ABM.

$$\sin\theta = \frac{BM}{AB} = \frac{BM}{d}.$$

$$\boxed{BM = d\sin\theta}$$

If 'θ' is very small,

then $\sin\theta = \theta$.

$$\boxed{BM = d\theta} \longrightarrow ②$$

In $\triangle COP$.

$$\tan\theta = \frac{OP}{CO} = \frac{x}{D}.$$

If θ is small.

$\tan\theta = \theta$.

$$\boxed{\theta = \frac{x}{D}} \longrightarrow ③$$

Sub. ② & ③ in ①,

$$\boxed{\delta = \frac{xd}{D}}$$

<u>Bright fringes</u>:

The condition to produce bright fringes is path difference should be $n\lambda$.

$$\frac{xd}{D} = n\lambda$$

$$\boxed{x = \frac{D}{d} n \lambda}$$

where $n = 0, 1, 2, 3 \ldots$ order of bright fringes.

Bright fringes are produced at a distance x from 0 corresponding to $n = 1, 2, 3$.

Dark fringes:

The condition for dark fringes to occur is path difference $= (2n-1)\lambda/2$.

$$x \frac{d}{D} = (2n-1)\lambda/2.$$

$$\boxed{x = \frac{D}{d}(2n-1)\lambda/2}$$

where $n = 1, 2, 3 \ldots$

Dark fringes occur at a distance x corresponding to $n = 1, 2, 3 \ldots$ above the central bright fringe.

Thus alternate dark and bright fringes above the central bright fringe.

Bandwidth :

Bandwidth is defined as the distance between two adjacent dark fringes or bright fringes.

For, two bright fringes, x_{n+1}, x_n, the bandwidth is given by.

$$x_{n+1} - x_n = \frac{D}{d}(n+1)\lambda - \frac{D}{d}n\lambda$$

$$\boxed{\beta = \frac{D}{d}\lambda}$$

For dark fringes, also the same bandwidth is obtained.

Above the central bright fringe, alternate dark and bright fringes appear.

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β can be increased by

(i) increasing the distance between source and screen

(ii) increasing wavelength of light.

(iii) decreasing the distance between the two slits.

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67) Postulates of Bohr model:

Bohr modified Rutherford's model, in order to explain the stability of the atom.

(i) An electron does not revolve around the nucleus in all possible orbits. An electron revolves around the nucleus only in certain permitted orbits in which the angular momentum of an electron is an integral multiple of $h/2\pi$

(h is Planck's constant $- 6.626 \times 10^{-34}$ Js)

In this orbit, the electron does not radiate energy. Hence these energy levels are called stationary levels (or) stationary orbits

If 'm', 'v' is mass and velocity of electron in permitted orbit of radius 'r', then the angular momentum of the electron is an integral multiple of $h/2\pi$.

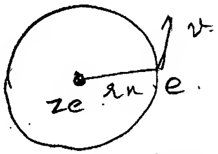
$$\boxed{mvr = \frac{nh}{2\pi}}$$

when $n = 1, 2, 3 \ldots$ principle quantum number.

This is called Bohr's quantisation condition.

2) An electron emits or radiates energy only when it jumps from higher energy state to lower energy state. If an electron jumps from E_2 (higher) to E_1 (lower), then then it radiates energy $\boxed{h\nu = E_2 - E_1}$.
This condition is called Bohr's frequency condition.

Radius of n^{th} orbit :



Let us consider the atom having nuclear charge Ze and an electron revolving around the nucleus in a circular orbit of radius r_n'

The nuclear charge is Ze where 'Z' is atomic number equal to number of protons which in turn equal to number of electrons.

The electrostatic force of attraction between the nucleus and the electron revolving in the orbit is

$$\boxed{F = \frac{1}{4\pi\varepsilon_0}\frac{(Ze)\,e}{r_n^2}} \rightarrow (1)$$

This force provides the necessary centripetal force for the electron revolving around the nucleus.

$$\boxed{F = \frac{mv^2}{r_n}} \rightarrow (2)$$

$v \rightarrow$ velocity of e in n^{th} orbit

Electrostatic force provides the necessary centripetal force

$$\boxed{\frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r_n^2} = \frac{mv_n^2}{r_n}} \rightarrow (3)$$

$$\frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{r_n^2} = \frac{m r_n^2 \omega_n^2}{r_n} \quad \left(\text{since } v_n = r_n \omega_n\right)$$

$$\boxed{\omega_n^2 = \frac{1}{4\pi\varepsilon_0}\frac{Ze^2}{m r_n^3}} \rightarrow (4)$$

By Bohr's first postulate,

$$\boxed{L = \frac{nh}{2\pi}} \rightarrow (5)$$

By, angular momentum of an electron

$$\boxed{L = mvr} \rightarrow (6)$$

equating (5) & (6)

$$\frac{nh}{2\pi} = m v_n r_n$$

$$m r_n^2 \omega_n = \frac{nh}{2\pi} \quad \left(\text{since } v_n = r_n \omega_n\right)$$

$$\omega_n = \frac{nh}{2\pi m r_n^2}$$

$$\boxed{\omega_n^2 = \frac{n^2 h^2}{4\pi^2 m^2 r_n^4}} \rightarrow (7) \quad (\text{squaring})$$

Equating (4) & (7).

$$\frac{1}{4\pi\varepsilon_0}\,\frac{Ze^2}{m\,r_n^3} = \frac{n^2h^2}{4\pi^2 m^2 r_n^4}$$

$$\boxed{r_n = \frac{n^2h^2\varepsilon_0}{\pi m Z e^2}}$$

∴ The radius of n^{th} orbit is proportional to the square of principle quantum number.

$$\boxed{r_n \propto n^2}$$

Thus, the radius of 1st 3 orbits are in the radius 1 : 4 : 9.

For hydrogen atom

$Z = 1$

$$\boxed{r_n = \frac{n^2h^2\varepsilon_0}{\pi m e^2}}$$

for, ~~n = 1~~,

$$\boxed{r_n = \frac{n^2h^2\varepsilon_0}{\pi m e^2}}$$

Substituting the known values,

For $n = 1$

$r_n = n^2 \times 0.53\ \mathring{A}$

$\therefore\ r_n = n^2 \times 0.53\ \mathring{A}$

From, $n = 1$

$$\boxed{r_1 = 0.53\ \mathring{A}}$$

This is called Bohr's radius.

68) Bainbridge Mass Spectrometer:

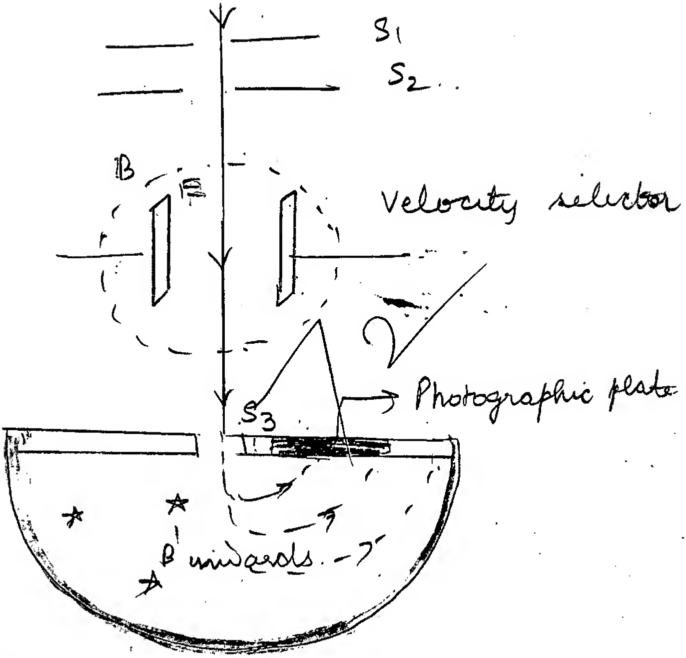
(i) <u>Function</u>:

The Bainbridge Mass spectrometer is an instrument used to measure the isotopic masses.

<u>Principle</u>:

The fact that charged particles are deflected by both electric and magnetic field is the principle used here.

Diagram :



Construction :

(i) An atom in which two or more electrons removed gains a net positive charge.

(ii) The positive ions from the discharge tube are passed through two narrow slits S_1 and S_2 and passes through velocity selector.

(iii) The velocity selector allows ions of only particular velocity to pass through it.

(iv) It consists of two parallel metal plates P_1 & P_2 which produce uniform electric field and electromagnet which produces uniform magnetic field.

(v) Ions of only particular velocity come out of velocity selector.

Determination of velocity :

(1) The force exerted by electric and magnetic field is adjusted so that, the liberated positive charges do not suffer any deviation.

The force exerted by electric field $Eq \rightarrow$ 'q' is ~~velocity~~ of charge of ions

The force exerted by magnetic field is BqV

V - velocity of ions.

$$Eq = BqV.$$

$$\Rightarrow \boxed{V = \frac{E}{B}} \rightarrow (1)$$

Determination of isotopic masses :

The ions of particular velocity are passes through narrow slit S_3 into an evacuated chamber D.

The ions are subjected to another magnetic induction B' acting inward $\perp^r$ to plane of paper.

The ions ~~tr~~averse a circular path and strike the photographic plate.

The centripetal force is provided by the magnetic feild.

$$B'qv = \frac{mv^2}{r}$$

$$m = \frac{B'qr}{v} \quad \left(\text{since } v = \frac{E}{B}\right)$$

$$\boxed{m = \frac{BB'qR}{E}}$$

Conclusion:

Ions of different velocity traverse circular path of different radii and strike the photographic plate.

The distance between the slit S_3 and point of striking gives diameter from which radius can be calculated.

From B, B', q, R, E, the mass of isotopes can be calculated.

3

69) Rectification :

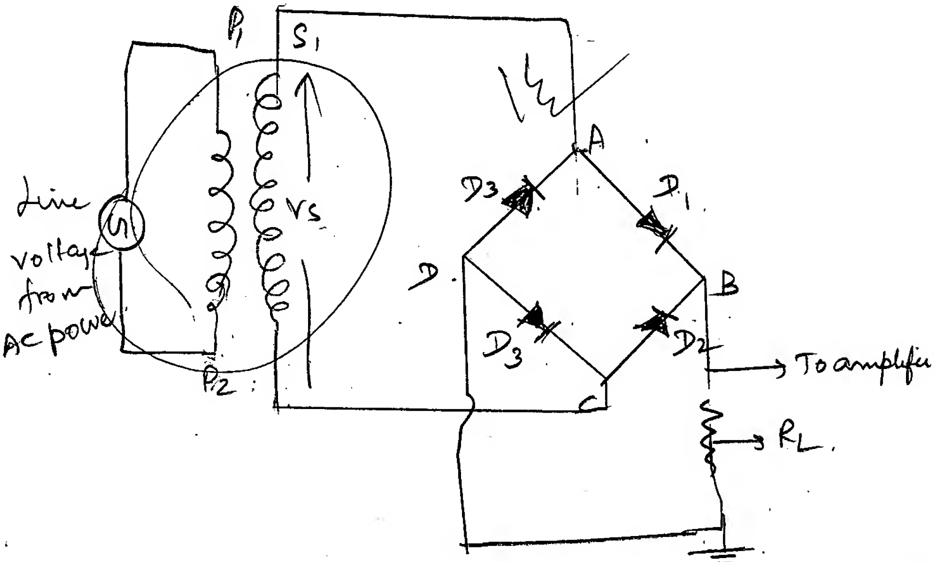
The process of converting alternating input voltage or curre into direct voltage or current is called rectification. The device is is called rectifier.

Rectifier offers low resistance and PN diode allows current to fl in forward biased condition. This the principle used here.

Bridge rectifier :

Bridge rectifier consists of fo diodes D_1, D_2, D_3, D_4 connected to fo a network.

Diagram :



The junctions B and D are connected to output through Load Resistance R_L.

The A and C are connected to secondary ends S_1 & S_2 of transformer

During +ve half cycle:

During +ve half cycle of input AC voltage, diodes, D_1 & D_3 are forward biased. Hence they conduct. The current flows through them S_1 ABDC S_3 through R

During -ve half cycle:

During -ve half cycle of input AC voltage, diodes D_2 and D_4 are forward biased and hence conduct and D_3 & D_1 are reverse biased and hence do not conduct.

The current flows across them, S_2CBDAS_1 through R_L.

3

During both the half cycles, output the current flows in the same direction.

The output voltage flows in the same direction for both the half cycles.

Thus DC current is obtained.

Efficiency:

The effeciency of bridge rectifier is 81.2%